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Indian Standard

EVALUATION OF COMPLETED IRRIGATION PROJECTS (MAJOR AND MEDIUM) — GUIDELINES

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Water Resources Planning, Management and Evaluation Sectional Committee had been approved by the Water Resources Division Council.

The concept of inspection into the performance and adoption of corrective steps of any system help in increasing its efficiency and river valley projects are no exception to this. The need to carryout performance evaluation study of the river valley projects is being increasingly felt over the word for the past few decades. Periodical evaluation of irrigation projects during their implementation is as important as their planning, owing especially to the massive investments made. The main objective of evaluation study is to find out how far the project has achieved the planned goals, and if not, what are the reasons/bottlenecks in not achieving the targetted benefits. This is a vital tool to focus apart from the benefits, the deficiencies in project planning and implementation. Thus it will help in improving the techniques of project formulation and also optimize the performance of the projects. Assessing the status of the system efficiency and deliveries and the problems enables planners to formulate a suitable strategy for extension, renovation or modernization of the systems

Indian Standard

EVALUATION OF COMPLETED IRRIGATION PROJECTS (MAJOR AND MEDIUM) — GUIDELINES

1 SCOPE

1.1 This standard provides guidance for carrying out the performance evaluation of completed irrigation projects (major and medium) with special emphasis on the irrigation component.

1.2 Evaluation of socio, agro, economic, environmental, ecological, hydropower generation, navigational, flood protection aspects and the assessment of various impacts of the projects on the climate, environment and ecology do not fall within the scope of this standard.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
4410	Glossary of terms relating to river valley projects:
(Part 1) : 1991	Irrigation practice (*first revision*)
(Part 3) : 1988	River and river training (*first revision*)
(Part 5) : 1982	Canals (*first revision*)
(Part 6) : 1983	Reservoirs (*first revision*)
(Part 12) : 1993	Diversion works (*first revision*)
(Part 15)	Canal structures,
(Sec 1) : 1973	General terms
(Sec 2) : 1973	Transitions
(Sec 3) : 1977	Flumes
(Sec 4) : 1977	Regulating works
(Sec 5) : 1992	Cross drainage works (*first revision*)
(Part 17) : 1977	Water requirements of crops

3 TERMINOLOGY

For the purpose of this standard, the definitions given in applicable parts of IS 4410 shall apply.

4 AGENCIES RECOMMENDED FOR CARRYING OUT THE STUDY

The concerned state governments should undertake the study through institutions having an unbiased approach with scientific aptitude. To the extent possible the agency should be competent in various disciplines like hydrology, irrigation hydraulics including irrigation structures and instrumentation, economics, agronomy, social sciences and operation and maintenance (O&M), consistent with the scope of study.

5 SELECTION OF PROJECTS FOR PERFORMANCE EVALUATION

Projects which have been completed and in operation for a period of five years or more and those projects for which no evaluation has been carried out for the past five years or more, consequent upon their extension, renovation, modernization (ERM) should be selected. Among such projects, those having a gap of 20 percent or more between the planned irrigation potential and its utilization should be identified for the purpose of evaluation study, at the first instance. However, all the projects under operation should be taken up in due course of time.

6 FREQUENCY OF CARRYING OUT PERFORMANCE EVALUATION STUDY

All the old irrigation systems constructed/executed during pre-independence period or those constructed 25 years ago should invariably be re-evaluated with regard to their performance. In any case, performance evaluation of the completed river valley projects should be done at least once in a period of 5 years. Any proposal for extension, renovation, modernization (ERM) of existing systems should be preceded by the performance evaluation study.

7 BASE FOR COMPARISON

7.1 The base for comparison of an existing irrigation project should generally be the objectives or targets envisaged at the time of design and implementation, or the objectives on which the project was approved. However, in the case of extension/renovation/modernization schemes, those objectives on which the project was revised during execution and finalized at the completion stage should be taken as the base. The scope of the project in the original report or as revised from time to time is always known and should be taken as the basis for comparison of performance evaluation.

7.2 It should be noted that sometimes, comparison with the targets taken from the project report may not reflect the true performance because annual inflows or availability of water may differ widely from those projected at the time of planning, or some other changes may have been introduced at subsequent stages. Therefore, the performance of an irrigation system gives a more realistic picture, if it is evaluated with reference to the targets projected for particular season. For example, availability of water before the *Rabi* season is generally known while the pattern of irrigation and the crop is decided before the season starts. Another reason could be that the infrastructure is not complete and that full irrigation potential of the project has not been reached.

Accordingly seasonal targets can be fixed and actual performance measured against them. At the same time, assessment only with reference to seasonal projections may also not reflect true performance. The assessment should therefore be made on both counts that is with reference to the project report and with seasonal projections. If the achievements fall short of the objectives provided in the project report consistently for many years, there could be a need to look at the original project to review and revise its scope or to carry out additions and alterations.

8 KEY INDICATORS FOR EVALUATION AND ANALYSIS

8.1 The main objectives of evaluation is to determine if the purpose for which the system has been set up is achieved or not and to discover whether different components of the system are functioning properly or not. These indicators should include irrigation performance objectives such as reliable water delivery and its optimal utilisation for crop production. Essential points such as equity, reliability, adequacy, regularity and durability, which are vital for successful management, should be kept in mind. Owing to wide variation in the size and scope of the irrigation projects in the country, indicators that are appropriate in one environment for one project may not be applicable for another. Operating experience can assist in listing of indicators useful for evaluation in a majority of cases. Some of the typical indicators are given in **8.2** to **8.7**.

8.2 Reservoir Operations

a) Inflows, spillages and releases;
b) Reservoir operation plan *vis-à-vis* actual operation;
c) Reservoir storage efficiency;
d) Reservoir sedimentation and likely effects on live storage capacity; and
e) Comparison with earlier years and comparison between different sub commands/reservoirs.

8.3 Conveyance System Performance

a) Canal conveyance efficiency;
b) Canal operations loss; and
c) Adequacy of water delivery.

8.4 Maintenance of Civil Works of System

a) Head works;
b) Canals;
c) Drains; and
d) Water control structures.

8.5 Drainage Performance

a) Water table fluctuation, seasonal and long term;
b) Drain effluents quality change (by area);
c) Drainage requirement change (by area); and
d) Water-logging and soil salinity change (by area).

8.6 Below the Outlet

a) Irrigation potential created and utilized;
b) Farm water use efficiency;
c) Conjunctive use of water;
d) Adequacy of irrigation method;
e) Adequacy of crop selection;
f) Production technique for irrigated agriculture;
g) Soil management and erosion control; and
h) Equity in water distribution and dependability.

8.7 The following are also important and should be covered in the evaluation process:

a) Organization of water distribution;
b) Communication system;
c) Cost of distribution of water;
d) Incentives and malpractices;
e) Participatory irrigation management (PIM) and training programmes for farmers;
f) Data collection and monitoring;
g) Total number of water users supplied;
h) Timely information about irrigation schedule to various farmers; and
j) Co-ordination between farmers and irrigation authorities.

9 DATA COLLECTION

9.1 Primary Data

The primary data given in **8.2** to **8.7** and information for the overall command area should be collected for a detailed study.

9.2 Maps

a) Index map (a scale of 1 : 250 000 is recommended);
b) Maps showing irrigation canal network, major drainages and other features of the command on a scale, as available;
c) Soil survey maps, as available;
d) Maps showing tube wells as also ground water observation wells on a scale of 1 : 250 000 or as available;
e) Village maps to a scale of 1 : 4 000 for commands of selected minors, showing irrigation network and other physical features; and
f) Irrigation revenue maps

9.3 Reports

a) Project reports as also completion report, if available;
b) Reports on cropping patterns and soil survey reports, if any;
c) Reports on appraisal studies, if available;
d) Irrigation manual of orders;
e) Reservoir operation manual; and
f) Model study reports of the hydraulic structures and sedimentation survey reports, conducted to assess sedimentation rates.

9.4 Physical Data

a) *Meteorological Data:*

1) *Rainfall* — Normal monthly rainfall data in the command area;
2) Normal monthly evaporation and evapotranspiration data and agro-climatic data; and
3) Temperature data.

b) *Hydrological Data:*

1) Water availability at head-works monthly data for last 5 years;
2) Monthly regulation data for overall system in various distributary networks and for selected minors for last 5 years;
3) Data of seasonal water table fluctuations and of depths of water table in the observation wells (if available);
4) Data on pumping tests on wells (if available);
5) Discharge data of regenerated water in drains (if available); and
6) Water quality data (if available).

9.5 Functional Data

9.5.1 *Agronomic Data:*

a) Agronomic practices, crop water requirements; and
b) Irrigation practices.

9.5.2 *Resource Use*

It should include land use and cropping patterns for overall command for the last 5 years.

9.5.3 *Details of Data of Irrigation Canals*

a) Gross and cultivable commands on the distributary networks;
b) Water scheduling and rostering of canals for last 5 years;
c) Public and private tube-wells functioning in the command for last 5 years;
d) Irrigated area — crop-wise for various distributary networks and for selected minors and on public tube-wells for the last 5 years; and
e) Irrigated area from tube-wells and drains in the project command for last 5 years.

9.5.4 *Details of Water Logged Areas and Salinization/ Alkalization in Overall Command and Data on Reclamatory Measures taken by Project Authorities, if Any*

9.5.5 *Rules and Procedures for Scheduling Supplies Among Canals*

a) Periodicity of irrigation schedules over the command, continuous or varying;
b) Scheduled operation of canals (full discharge or at lower or greater discharges); and
c) Opening and closing dates for the canals and closure periods.

9.5.6 *Rules and Procedures and Methods for Distribution of Supplies Among Farmers in the Outlet Commands*

9.5.7 *Rules and Procedures for Regulation and Control of Irrigation Supplies*

a) Operation manuals;
b) Operation monitoring system — Management Information System (MIS) and Decision Support System (DSS);
c) Regulation and control system and its structure;
d) Interference by the farmers with canal flows and irrigation schedules; and
e) Interference from outside agencies.

9.5.8 *Operation and Maintenance Norms*

9.5.9 *Operation and Maintenance Funds*

9.5.10 *Organization for Regulation and Water Management:*

a) O&M staff, trained and untrained;
b) Tenure of O&M staff and changes in posting;
c) Powers of O&M staff to deal with infringements and interference by farmers and legislation in force, if any;
d) Staff incentive structure for O&M; and
e) Discipline in operation by staff.

9.6 Secondary Data

In addition to the primary data as outlined in **9.1** to **9.5** which will be useful for detailed study, additionally critical data is also necessary for performance evaluation of the system. This is to be obtained by carrying out field observations and investigations on main canal, on three representative distributaries — one in head reach, one in central reach and one in tail reach, and in the commands of one or two minors on each of three representative distributary systems, selected on the basis of parameters of hydrologic soil classification, groundwater, drainage, etc.

9.7 The following field investigations and observations are also necessary:

a) Survey for inventory of wells/tube-wells and for ascertaining capacity/discharges and annual drafts for outlet commands of selected minors. Assessment of annual drafts will be based on reconnaissance surveys and queries in the field. Water quality of groundwater should also be ascertained.
b) Operation and conveyance losses on stretches of main canal, representative distributaries and selected minors and water courses (Conveyance losses may be measured by inflow — outflow method).
c) Sample surveys in both crop seasons for irrigation methods, depth and frequency of irrigation, effective rainfall and crop yield for principal crops *vis-a-vis* soil conditions, nature of water and other agricultural inputs, size holdings, etc, in typical canal irrigated fields on sample outlets.
d) Similar observations are necessary for relevant crops for each type of irrigation facility (well irrigation, canal irrigation and canal irrigation supplemented by well irrigation).
e) Sample survey for cropping patterns in irrigated areas and in outlet commands in three outlets on each selected minor and their comparison with department records and design expectations. The survey is to be based on reconnaissance and queries in the field.

10 Review and Analytical Study of Data

10.1 Macro-level Study

Review of policy and objectives should be made in regard with distribution of available supplies among farmers and cropping patterns adopted and crops grown, and of the effect and adequacy of irrigation and related acts and supplemental rules framed on the objectives. Enforcement of codal provisions with the real situation should be reviewed. History of the project should be referred so as to ascertain some of the issues involved in the completion of the project.

10.2 Studies for Evaluation of Performance for Existing Irrigation System

10.2.1 *Review of Water Availability and Utilization*:

a) *Pattern and extent of surface water availability*: The data of surface water supply availability of the head of barrage main canal systems and that passed on should be collected and compared. If there are deviations, the reasons should be ascertained and measures necessary for affecting availability be indicated.
b) *Groundwater development in the command*:
    1) Review should be made of ground water development in overall command of the system.
    2) Status of groundwater development through private and public wells should be ascertained. The conjunctive use system as prevalent and its efficacy should be studied. It should be examined, if any change in policy is required.
c) *Return flow availability for re-use in the command*: Reconnaissance surveys should be carried out to locate the drains with flowing water in the command in different periods of the year.

10.2.2 *Review of Irrigation System*

a) Main canal and distributary canal systems (canals and off-takes) with respect to adequacy of capacity of canals and regulators and other structures:
    1) Longitudinal sections and cross-sections of main canal and irrigation distribution network.
    2) Layout and geometry of irrigation canal

    network, lined and unlined and their capacities at heads and strategic points.
    3) Canal roughness and conveyance and operation as well as run-off losses in channel system.
    4) Location and details of head and cross regulators and their control system.
    5) Location and capacities of escapes and outlets for various water levels in canals and distributaries.
    6) Dummy regulators and drainage arrangements in lined channels.

b) *Distribution systems in outlet commands:*

    1) Outlets (size and type) and discharge capacities in the command areas.
    2) Pattern of distribution of supplies among outlets.
    3) Adequacy of watercourses and field canals in command outlets and their state of maintenance.
    4) Adequacy of on-farm development (OFD) works (field canals — lined and unlined, chak roads and field drainage) and state of maintenance of OFD works.
    5) Status of land levelling and land shaping of fields.
    6) Estimation of seepage and runoff losses in watercourses and field canals.

c) *Drainage system:*

    1) Adequacy of the network of connecting and primary drains;
    2) Adequacy of the capacity of drains; and
    3) State of maintenance.

10.2.3 *Review of Water-Logging Problems*

a) From study of depth of ground water table maps, the effect of irrigation on ground water level over time, and the areas prone to water-logging should be ascertained.
b) Soil salinity/alkalinity problem should be ascertained. The areas with salinity/alkalinity problem should be identified on the basis of reconnaissance surveys and contact with public and officials. Provision of funds to mitigate the problem and remedial measures proposed by the project authorities and the action research programme should be critically analyzed.
c) Water quality of drainage water should be ascertained, and seen as to what extent it can be re-used for irrigation and other purposes.

10.2.4 *Review of Water Allocations and Scheduling Plan*

a) Available supplies, canal regulation and water scheduling procedures *vis-a-vis* weather conditions, frequency of irrigation and irrigation methods for predominant crops should be reviewed.
b) Scheduling of supplies by farmers *vis-a-vis* optimum timings of irrigation should be reviewed.
c) Decision making process in water allocation about adequacy and scope of decentralisation of certain functions should be studied.

10.2.5 *Review of Monitoring System and Communication Network*

a) Review of system of data collection, processing and analysis in respect of water availability, scheduling and supplies, and their utilisation in regulation and comparison with actual situation.
b) Review of communication system in respect of adequacy and reliability.

10.2.6 *Agricultural Performance*

a) Cropping patterns, irrigated crop areas and intensities;
b) Supplies reaching fields and those consumptively used by crops;
c) Crop yields and agricultural income; and
d) Extent of ground water and drainage reuse in meeting agricultural demand.

10.2.7 *Evaluation of Reaction of Farmers to the Performance/Impact of Irrigation Project with Respect to:*

a) Water availability;
b) Adequacy of OFD programme;
c) Adequacy of inputs and support services;
d) Adequacy of water distribution system among farmers;
e) Information to farmers about operating procedures, scheduling of supplies, opening and closing dates for the channels and closure periods;
f) Arrangement of co-ordination and consultation among farmers and officials; and
g) Attitude of the farmers to the project.

The key constraints in the system are to be analysed and the works to be remodelled or new works to be provided should be identified.

11 PERFORMANCE EVALUATION OF IRRIGATION SYSTEM

11.1 Macro-level study will be carried out and evaluation of performance of existing irrigation system as described in **10** should be made. The available data of irrigation system shall be studied and following points should be considered:

a) Fulfilment of design expectations about water availability.

b) Comparability of water allocations to those complied by operation rules.

c) Comparison of design canal and off-take capacities compared with design capacity.

d) Maintenance and its affect on system performance. State of maintenance should be ascertained by study of longitudinal sections and of logbooks of works based on inspections and surveys carried out during operation as well as closure periods.

e) Integration of other resources of water (ground water, tanks and drainage reuse) with the canal system and their contribution to the water availability.

f) Frequency of monitoring/reporting of system operations and presence of arrangements for regulating and controlling the system.

g) Frequency of surprise inspections and presence of a regular system of surprise inspections or are these made only after receipt of either a complaint from a group of farmers or the directions from higher authorities.

h) Comparison of actual irrigated areas with design expectations.

j) Extent of adherence to present operating rules and procedures, specified irrigation schedules among canals, opening/closing dates, distribution of supplies among outlets and farmers, and cropping calendars.

k) Comparison of cropping patterns and intensities with design objectives and reasons of the differences between them, if any.

m) Existence of water-logging and salinity conditions in some of the areas and the reasons for the same (inadequacy or lack of farm agricultural drainage system and connecting and primary drains). The water logged areas and other areas where water table is rising should be identified by review of ground water table in the command area, available with ground water investigation organization. The information of soil salinity/alkalinity should be collected from block level supplemented by study of the soil survey data as available and by reconnaissance survey.

n) Availability/passage of information to farmers about operation procedures, opening and closing dates, and irrigation schedules.

p) Adequacy of land development programme and the relevant organisational setup for its implementation.

q) Interference by farmers with control structures, canal flows and irrigation schedule.

11.2 Review of Status of Water and Crop Management

11.2.1 This includes assessment of the present status of water management system for assessment of irrigation needs, use of weather forecasts in such assessment, organisational set up and communication system, of management information and reporting system and the regulation and operation system of canal supplies. This also includes ensuring the adequacy of facilities for education of beneficiaries and management staff for affecting better use of the available supplies.

11.2.2 Status of crop management, that is organization and programmes of agricultural extension services including plant protection measures, and research programmes and their infrastructure and the extent of association of universities and research institutions in the research programmes.

11.2.3 Status and adequacy of marketing facilities such as location of markets, network of roads and transport.

11.2.4 Presence of proper arrangement of co-ordination and consultation among farmers and officials. Extent of involvement of farmers in the water management and maintenance of watercourses, field channels and drains should be studied.

11.2.5 For projects covered under the centrally sponsored command area development programme (CADP) the status of on-farm development (OFD) works in regard to the following should be ascertained:

a) Selection and introduction of suitable cropping patterns;

b) Development of ground water to supplement surface irrigation;

c) Development and maintenance of main and intermediate drainage system; and

d) Provision of rotational water supply (*Warabandi*).

The status of adaptive research for evolving suitable soil-water-crop relations and management techniques suitable to the condition of farmers' fields should also be ascertained.

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